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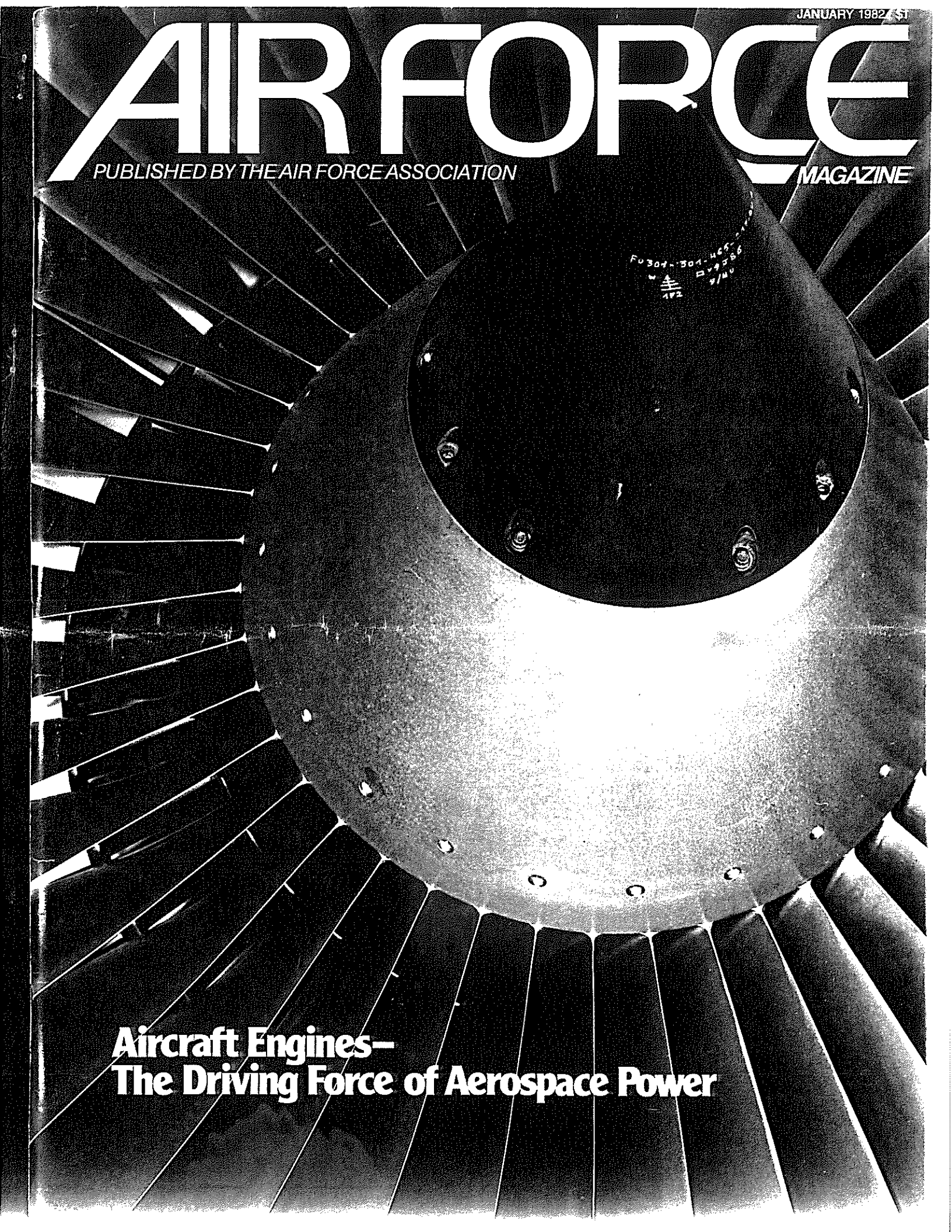


Aircraft Engines— The Driving Force of Aerospace Power

When the first Luftwaffe jet fighters slashed through Eighth Air Force bomber formations late in World War II, they stunned the aviators who had to fight against them. No propellers, very high speeds, and a surprise. US development of jet engines had lagged. In the UK, developments were much further along, but operational aircraft were not in the fray.

The Great Jet Engine Race... And How We Lost

BY LEE PAYNE
Illustration by Leslie Dunlap

THE year is 1935. Three men—one in England, one in Germany, and one in the United States—have reached the same conclusion: The world is ready for a new type of airplane engine.

"Concurrence," an idea that occurs simultaneously to different people, is not unusual in science. In this case, dissatisfaction with the reciprocating engine as an aircraft powerplant is widely recognized. All that is needed is someone to bridge the creative gap between the problem—the limitations of the reciprocating engine—and the solution, the development of an effective gas turbine—a jet engine.

The Englishman is an RAF officer in his mid-twenties. In January 1930, he had applied for his first patent, an ordinary reciprocating engine driving a compressor to produce a jet. Although his patent was similar to one issued years earlier to a Frenchman, the RAF is impressed and sends the young man to Cambridge University for two years. His name is Frank Whittle.

The German is a student of applied physics and mathematics at the University of Göttingen. His first patent is granted in 1934. The German is Pabst von Ohain, also in his mid-twenties.

The American has a head start. In his mid-thirties, he is already chief of structural research at the Douglas Aircraft Co. in Santa Monica, Calif. He has helped build the world's first successful all-metal dirigible. His name is Vladimir Pavlecka, and he has been working on a gas-turbine engine since 1933.

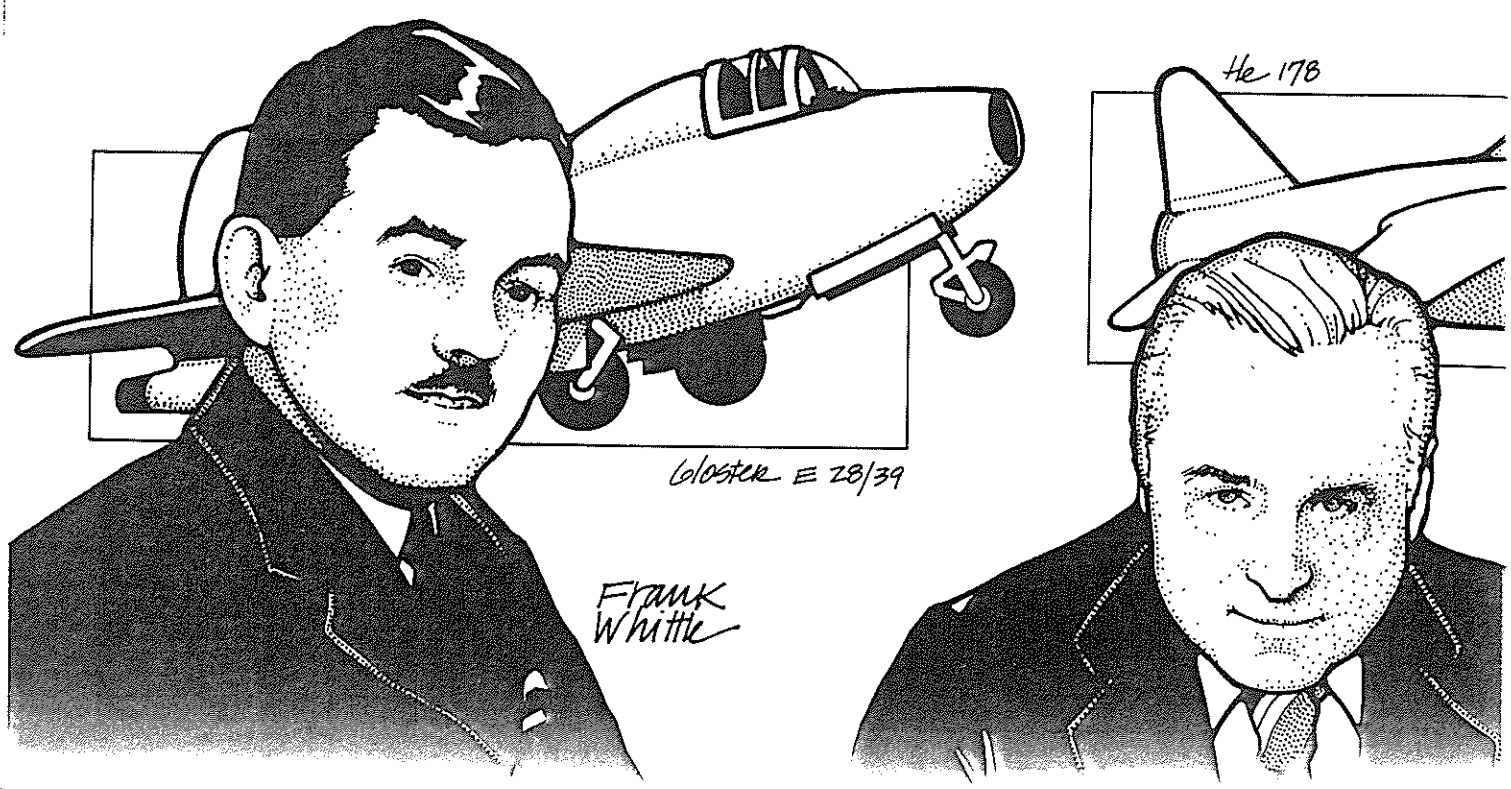
First Steps

In England, Frank Whittle enlists the aid of two former RAF officers who arrange a meeting with two investment bankers, Sir Maurice Bonham-Carter and Lancelot Law Whyte.

In Germany, graduate student Pabst von Ohain takes his problem to a professor at the University of Göttingen, R. W. Pohl. Pohl is a personal friend of airplane builder Ernst Heinkel.

In the US, Vladimir Pavlecka turns to Douglas, for whom he has already helped develop the concept of light metal airplane structures.

Whittle's RAF friends show his designs to M. L. Bramson, a widely respected consulting engineer, who arranges a meeting with Bonham-



Carter and Whyte. The two are interested in projects considered too speculative for conservative investment firms.

Lancelot Whyte meets the twenty-eight-year-old Whittle on September 11, 1935.

"The impression he made was overwhelming," Whyte recalls. "I have never been so quickly convinced, or so happy to find one's highest standards met. . . . This was genius, not talent.

"Whittle expressed his idea with superb conciseness: 'Reciprocating engines are exhausted. They have hundreds of parts jerking to and fro, and they cannot be made more powerful without becoming too complicated. The engine of the future must produce 2,000 hp with one moving part: a spinning turbine and compressor.' "

In Germany, even though his airframe company has never built an aircraft engine, Heinkel hires the young von Ohain.

In the US, Douglas sends Pavlecka's proposal to engine manufacturer Pratt & Whitney, who forwards it to MIT. The MIT and Pratt & Whitney engineers agree: Even if the engine worked, which it won't, there would be nothing useful for it to do. They are unanimous in their disinterest of the jet engine.

In March 1936, Power Jets Ltd. is formally incorporated. Whittle, still an RAF officer, is chief engineer. The Air Ministry, after examining Whittle's proposal, determines that his engine will never have military value but allows him to spend six hours a week working for the new company.

In October, a Power Jets bid for an Air Ministry research grant is turned down and work continues with private funds. Though Whittle would prefer to build and test each engine component separately, suitable test equipment does not exist and it would be too expensive and time-consuming to build. They decide to build the entire engine all at once.

Von Ohain begins work at Ernst Heinkel Flugzeugwerke in February 1936. Heinkel's engineers have doubts but decide to build a simple demonstration engine out of sheet metal.

At Douglas, Pavlecka has not been idle. In 1936 he designs the company's first pressurized fuselage for the DC-4; develops the first tricycle landing gear ever used on a large plane; invents a self-sealing fuel tank; and switches Douglas from extruded sections to rolled sheet metal sections, thus making Douglas the first company to adopt today's industry standard.

In the face of almost universal skepticism about the jet engine, But Pavlecka is not discouraged: "Never," he says. "I knew the history of the gas turbine from Armengaud in France to Lysholm in Sweden and to Brown-Boveri in Switzerland. Dr. Adolph Meyer, the chief engineer at Brown-Boveri had been a guest in my home, though he didn't believe the gas turbine could ever be made light enough to fly. I knew the history. The experts at MIT and Pratt & Whitney didn't and this meant they would miss out on the beginning of this new industry. I knew I was right."

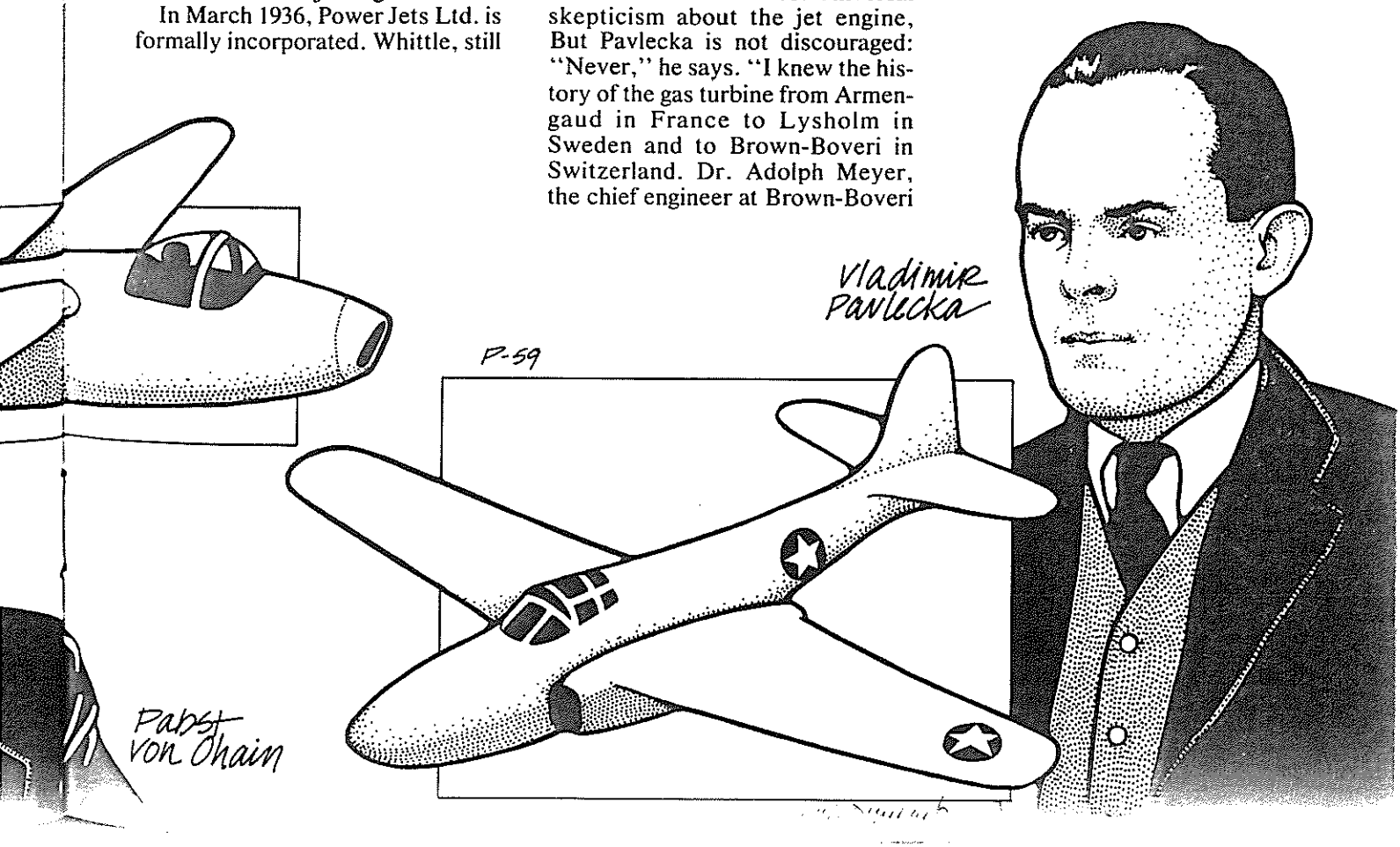
Early Advances

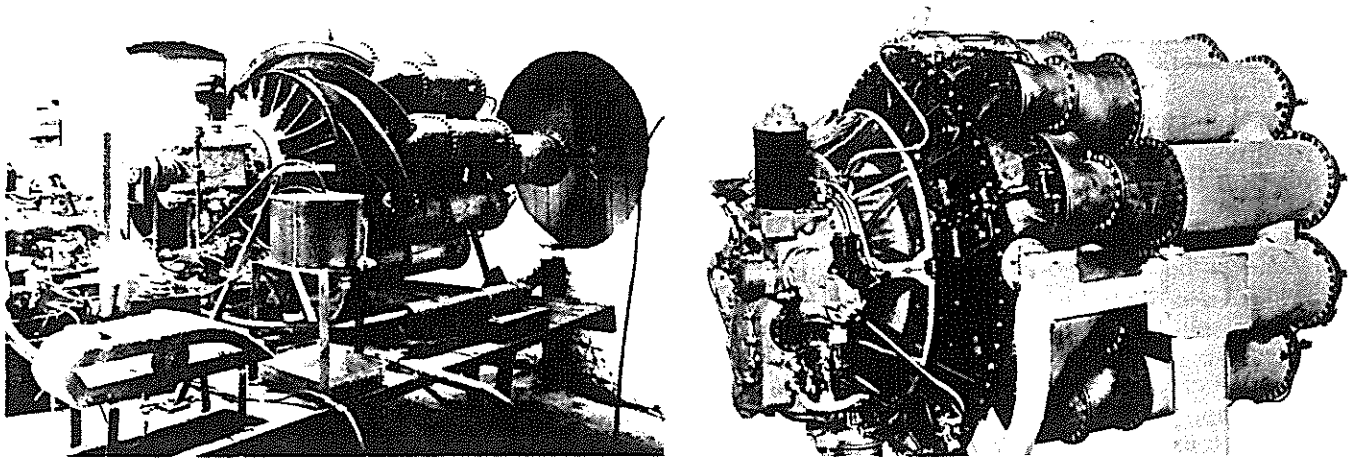
In March 1937, the world's first jet engine roars into life—in Germany. It has taken von Ohain and three assistants eleven months and $20,000. Their simple demonstration engine develops 550 pounds of thrust, more than enough to silence doubters.

Work begins immediately on a flight engine and on an aircraft for it.

A month later in England, Whittle's engine faces its first test. Built by the British Thomson-Houston Co. at a cost to Power Jets Ltd. of $30,000, it works. Though its output is less than the 1,100 pounds of thrust Whittle hoped for, the fact that it even runs is encouraging.

Below, the three main players in the development of jet engines, and the first jet-powered aircraft: Frank Whittle and the Gloster E28/39, Pabst von Ohain and the He 178, and Vladimir Pavlecka and the Bell P-59.





Left, the first experimental engine built by Frank Whittle, after having been rebuilt twice, in an unused foundry at Lutterworth. Right, the production version of Whittle's engine, the Welland. (Photo courtesy Rolls-Royce Ltd.)

Though financing remains a problem, the government finally agrees to contribute $5,000 and allows Whittle to work on the project full time while drawing his RAF salary. But the government shrouds the entire project in military secrecy, making it even harder to interest investors.

In the US, Douglas is building the world's largest airplane, the B-19, featuring Pavlecka's tricycle landing gear and self-sealing fuel tank. The company is uninterested in the jet engine. Meanwhile, Pavlecka and his staff invent flush riveting, a major breakthrough in reducing drag.

Whittle's improved engine is fired up in April 1938. It runs for four and a half hours before coming apart; it is rebuilt and tested again in October. The lack of money continues to hinder development.

Von Ohain tests his first flight engine at midyear. Designed for 1,800 pounds' thrust, like Whittle's, it too falls short and the job of reworking it begins.

A second German jet engine has been under development since 1936, also in strict secrecy. The second jet is also being built by an airframe company, Junkers Flugzeugwerke A.G., with no previous engine experience. Even after the Junkers Airplane Co. merges with the Junkers Motorenbau GmbH, the project is kept secret from the new firm's engine division. Herbert Wagner, chief of airframe development, feels the engine division is overly cautious and conservative. Wagner sets up his own engine works. With thirty designers under the direction of Max Mueller, the Junkers jet is ready for its first test in mid-1938. It works but cannot be made to run under its own power.

At Douglas, Pavlecka invents the internal hexagonal stop nut, still standard on today's aircraft, and develops a method of hydropressing with rubber pads that remains a master tool in airplane fabrication. Even though three jet engines have been built and tested, few in the US believe the idea is feasible.

Moving Into High Gear

By 1939, Europe is slipping toward war and the British government's Director of Scientific Research finally becomes convinced of the Whittle engine's practicality. The government agrees to fund further development, including a flight engine and a plane for it. The Gloster Aircraft Co. is asked to begin work on an airframe.

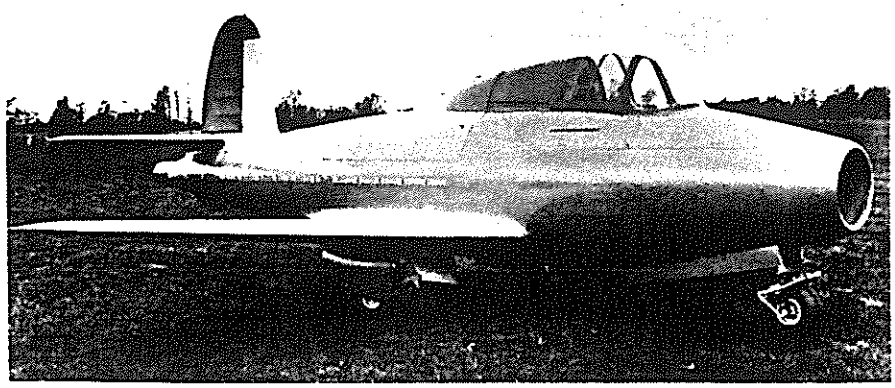
The German government has also begun to take the jet engine seriously and its Air Ministry steps up organization.

The engine companies are ordered into jet development and the airframe companies are ordered out. BMW, Bramo, and the Junkers engine division agree to begin preliminary design work.

Junkers has no objection to the transfer of jet development to its engine division but its jet engineers do. All but two quit and half are hired by Heinkel.

On August 27, 1939, a Heinkel airplane, the He 178, powered by a single von Ohain engine, the He S-3b, makes the first jet-powered flight in history. Ernst Heinkel has proved that an airframe company can build an engine.

And in the US, former Douglas engineer John Northrop plans to start his own company and asks Pavlecka to join him as chief of research. "I will," says Pavlecka, "but only if you will seriously consider building a jet engine."



The Gloster E28/39 was the world's second jet-powered aircraft to fly. Its first flight was on May 15, 1941. (Photo courtesy Gloster Saro Ltd.)